Chapter 1

Tapping into Formula and Function Fundamentals

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In This Chapter

- Getting the skinny on workbooks and worksheets
- Understanding the parts of a worksheet
- Working with cells, ranges, named areas, and tables
- Applying formatting
- Figuring out how to use the Help system
- Writing formulas
- Using functions in formulas
- Using nested functions

Excel is to computer programs what a Ferrari is to cars: sleek on the outside and a lot of power under the hood. Excel is also like a truck — it can handle all your data, lots of it. In fact, in Excel 2007, a single worksheet has 17,179,869,184 places to hold data. Yes, that's what we said — over 17 *billion* data placeholders. And that's on just *one* worksheet!

Opening files created in earlier versions of Excel may show just the number of worksheet rows and columns available in the version the workbook was created with.

Excel is used in all types of businesses. And you know how that's possible? By being able to store and work with any kind of data. It doesn't matter whether you're in finance or sales, whether you run a video store or organize wilderness trips, or whether you're charting party RSVPs or tracking the scores of your favorite sports teams — Excel can handle all of it. Its number-crunching ability is just awesome! And so easy to use!

Just putting a bunch of information on worksheets doesn't crunch the data or give you sums, results, or analyses. If you want to just store your data somewhere, you can use Excel or get a database program instead. In this book, we

show you how to build formulas and how to use the dozens of built-in functions that Excel provides. That's where the real power of Excel is — making sense of your data.

Don't fret that this is a challenge and that you may make mistakes. We did when we were ramping up. Besides, Excel is very forgiving. It won't crash on you. Excel usually tells you when you made a mistake, and sometimes it even helps you to correct it. How many programs do that!? But first the basics. This first chapter gives you the springboard you need to use the rest of the book. We wish books like this were around when we were introduced to computers. We had to stumble through a lot of this.

Working with Excel Fundamentals

Before you can write any formulas or crunch any numbers, you have to know where the data goes. And how to find it again. We wouldn't want your data to get lost! Knowing how worksheets store your data and present it is critical to your analysis efforts.

Understanding workbooks and worksheets

A *workbook* is the same as a file. Excel opens and closes workbooks, just as a word processor program opens and closes documents. Click the Microsoft Office button, found at the upper left of your Excel screen, to view the selections found under the File menu in earlier versions of Excel. Figure 1-1 shows the new look for accessing basic functions such as opening, saving, printing, and closing your Excel files (not to mention a number of other nifty functions to boot!).

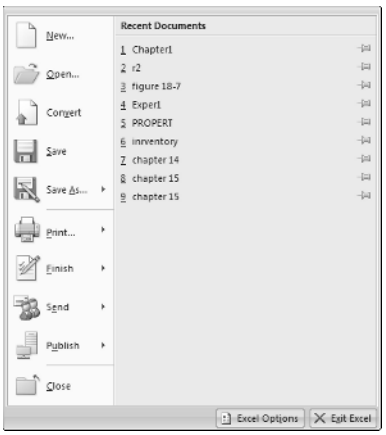


Figure 1-1: Seeing how to use basic Excel program functions.

Excel 2007 files have the .xlsx extension. Older version Excel files have the .xls extension.

When Excel starts up, it displays a blank workbook ready for use. If at any time you need another new workbook, click the Microsoft Office button and click on New. You will be presented with a plateful of templates, including a blank workbook. That's the baby you want, so give it a click to select it and then click the Create button. A new workbook will open. When you have more than one workbook open, you pick the one you want to work on by selecting it in the Windows Taskbar.

A worksheet is where your data actually goes. A workbook contains at least one worksheet. If you didn't have at least one, where would you put the data? Figure 1-2 shows an open workbook that has three sheets — Sheet1, Sheet2, and Sheet3. You can see these on the worksheet tabs near the bottom left of the screen.

At any given moment, one worksheet is always on top. In Figure 1-2, Sheet1 is on top. Another way of saying this is that Sheet1 is the *active* worksheet. There is always one and only one active worksheet. To make another worksheet active, just click its tab.

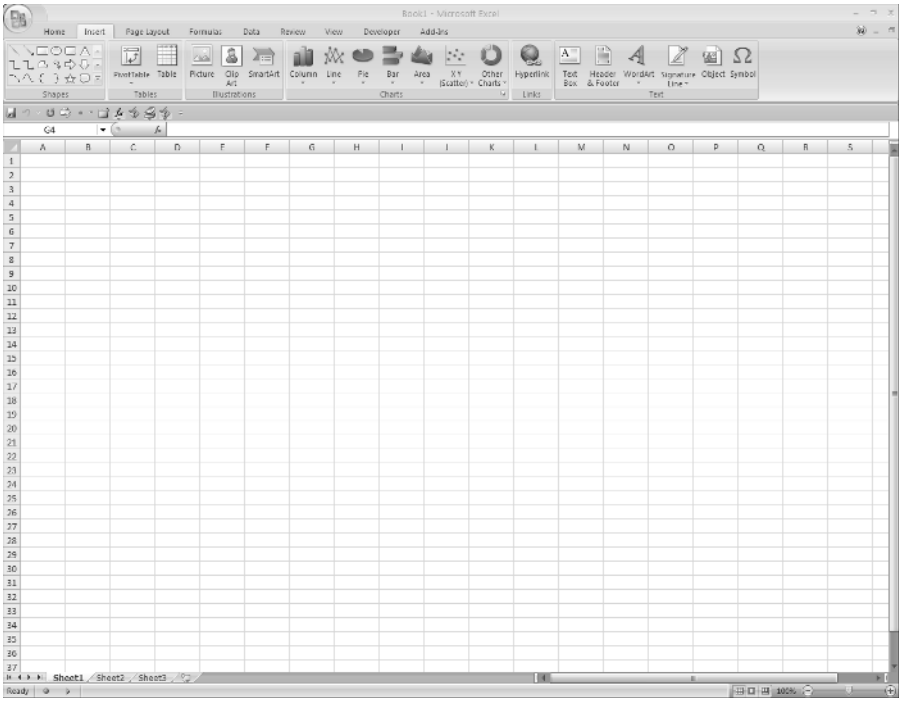


Figure 1-2: Looking at a workbook and worksheets.

Worksheet, spreadsheet, and just plain old *sheet* are used interchangeably to mean the worksheet.

Guess what's really cool? You can change the name of the worksheets. Names like Sheet1 and Sheet2 are just not exciting. How about Baseball Card Collection or Last Year's Taxes? Well, actually Last Year's Taxes isn't too exciting either.

The point is you can give your worksheets meaningful names. You have two ways to do this:

- Double-click the worksheet tab and then type in a new name.
- Right-click the worksheet tab, select Rename from the list, and then type in a new name.

Figure 1-3 shows one worksheet name already changed and another about to be changed by right-clicking its tab.

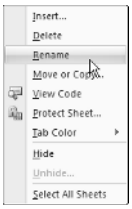


Figure 1-3: Changing the name of a worksheet.

You can try changing a worksheet name on your own. Do it the easy way:

1. **Double-click a worksheet's tab.**
2. **Type in a new name and press Enter.**

You can change the color of worksheet tabs. Right-click the tab and select Tab Color from the list.

To insert a new worksheet into a workbook, click the Insert sheet tab, which is located after the last worksheet tab. Figure 1-4 shows how. To delete a worksheet, just right-click the worksheet's tab and select Delete from the list.

Don't delete a worksheet unless you really mean to. You cannot get it back after it is gone. It does not go into the Windows Recycle Bin.

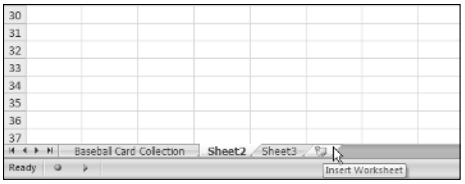


Figure 1-4: Inserting a new worksheet.

You can insert many new worksheets. The limit of how many is based on your computer's memory, but you should have no problem inserting 200 or more. Of course we hope you have a good reason for having so many. Which brings us to the next point.

Worksheets organize your data. Use them wisely and you will find it easy to manage your data. For example, let's say you are the boss (we thought you'd like that!), and you have 30 employees that you are tracking information on over the course of a year. You might have 30 worksheets — one for each employee. Or you might have 12 worksheets — one for each month. Or you may just keep it all on one worksheet. How you use Excel is up to you, but Excel is ready to handle whatever you throw at it.

New Excel files default to having three worksheets. You can change this default number on the Personalize tab in the Excel Options dialog box. To display the dialog box, click the Microsoft Office button and then click the Excel Options button.

Introducing the Formulas Ribbon

It's a fact of life — or rather, a fact of Microsoft marketing — that each new release of Office has a slightly different look. The folks at Microsoft went whole hog with Office 2007. Imagine this — no menus or toolbars. These have been such staples of Windows applications that only something amazing could upstage them.

Without further ado, we present the Ribbon. The Ribbon sits at the top of the application where menus used to unfold and toolbars made their home. A few items do appear as menu headers along the top of the Excel screen, but they actually work more like tabs. Click them and no menus appear. Instead, the Ribbon presents the items that are related to the clicked header.

Figure 1-5 shows the top part of the screen, in which the Ribbon displays the items that appear when you click the Formulas header. In the figure, the Ribbon is set to show formula-based methods. Along the left, functions are categorized. One of the categories is opened to show how you can access a particular function.

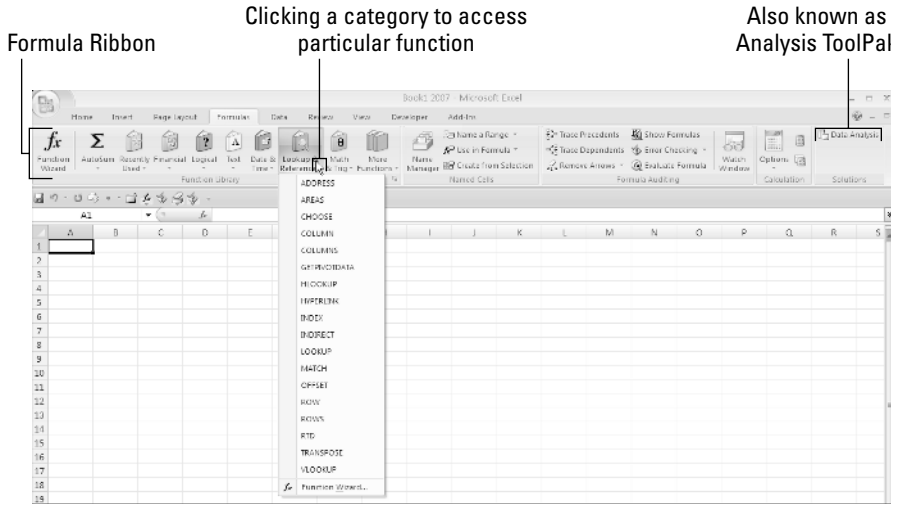


Figure 1-5: Getting to know the Ribbon.

These categories are along the bottom of the Formulas Ribbon:

- **Function Library:** This includes the Function Wizard, the AutoSum feature, and the categorized functions.
- **Named Cells:** These features manage named areas. In fact, the new Name Manager is here, a brand-new Excel 2007 feature.
- **Formula Auditing:** These features have been through many Excel incarnations, but never before have the features been so prominent. Also here is the Watch Window, which lets you keep an eye on the values in designated cells, but within one window. In Figure 1-6 you can see that a few cells have been assigned to the Watch Window. If any values change, you can see in the Watch Window. Note how the watched cells are on sheets that are not the current active sheet. Neat!
- **Calculation:** This is where you manage calculation settings, such as whether calculation is automatic or manual.
- **Solutions:** Any loaded add-ins that provide further functions appear here. In Figure 1-5, the Data Analysis Add-in is just another name for the ever-popular Analysis ToolPak.

Another new feature that goes hand in hand with the Ribbon is the Quick Access Toolbar. (So there is a toolbar after all!) In Figure 1-5 the Quick Access Toolbar sits just under the left side of the Ribbon. On it are icons that perform actions with a single click. The icons are ones you select by using the Customization tab in the Excel Options dialog box. You can put the toolbar above or below the Ribbon by right-clicking the Quick Access Toolbar and choosing the option.

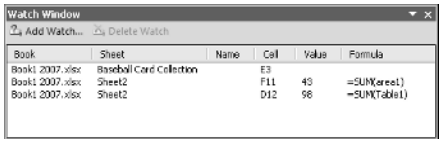


Figure 1-6: Eyeing the Watch Window.

Working with rows, column, cells, ranges, and tables

A *worksheet* contains cells. Lots of them. Billions of them. This might seem unmanageable, but actually it's pretty straightforward. Figure 1-7 shows a worksheet filled with data. Use this to look at a worksheet's components. Each *cell* can contain data or a formula. In Figure 1-7, the cells contain data. Some, or even all, cells could contain formulas, but that's not the case here.

Columns have letter headers — A, B, C, and so on. You can see these listed horizontally just above the area where the cells are. After you get past the 26th column, a double lettering system is used — AA, AB, and so on. After all the two-letter combinations are used up, a triple-letter scheme is used. Rows are listed vertically down the left side of the screen and use a numbering system.

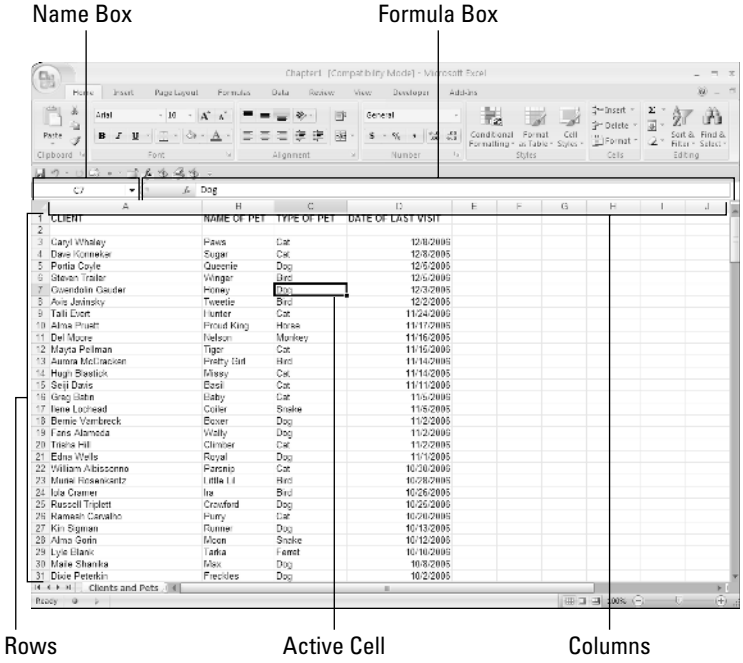


Figure 1-7: Looking at what goes into a worksheet.

Getting to know the Formula Bar

Taken together, the Formula Box and the Name Box make up the Formula Bar. You use the Formula Bar quite a bit as you work with formulas and functions. The Formula Box is used to enter and edits formulas. The Formula Box is the long entry box that starts in the middle of the bar. When you enter a formula into this box, you then can click the little check-mark button to finish the entry. The check-mark button is only visible when you are entering a formula. Pressing the Enter key also completes your entry; clicking the X cancels the entry.

An alternative is to enter a formula directly into a cell. The Formula Box displays the formula as it is being entered into the cell. When you want to see just the contents of a cell that has a formula, make that cell active and look at its contents in the Formula Box. Cells that have formulas do not normally display the formula, but instead display the result of the formula. When you want to see the actual formula, the Formula Box is the place to do it. The Name Box, on the left side of the Formula Bar, is used to select named areas in the workbook. This is addressed further in the material.

You find cells at the intersection of rows and columns. Cell A1 is the cell at the intersection of column A and row 1. A1 is the cell's *address.* There is always an *active* cell — that is, a cell in which any entry would go into should you start typing. The active cell has a border around it. Also, the contents of the active cell are seen in the *Formula Box.*

When we speak of, or reference, *cell,* we are referring to its address. The address is the intersection of a column and row. To talk about cell D20 means to talk about the cell that you find at the intersection of column D and row 20.

In Figure 1-7, the active cell is C7. You have a couple of ways to see this. For starters, cell C7 has a border around it. Also notice that the column head C is shaded, as well as row number 7. Just above the column headers are the Name Box and the Formula Box. The Name Box is all the way to the left and shows the active cell's address of C7. To the right of the Name Box, the Formula Box shows the contents of cell C7.

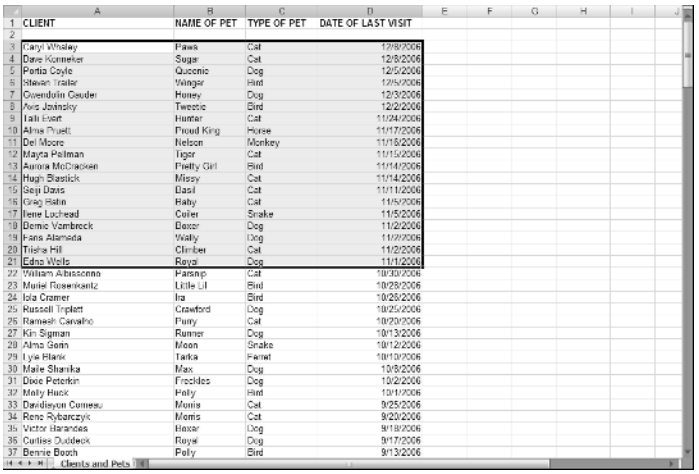
If the Formula Bar is not visible, choose the Advanced tab; in the Display section in the Excel Options dialog box, choose to make it visible.

A *range* is usually a group of adjacent cells, although noncontiguous cells can be included in the same range (but that's mostly for rocket scientists and those obsessed with calculus). For your purposes, assume a range is a group of continuous cells. Make a range right now! Here's how:

1. **Position the mouse pointer over the first cell where you wish to define a range.**
2. **Press and hold the left mouse button down.**
3. **Move the pointer to the last cell of your desired area.**
4. **Release the mouse button.**

Figure 1-8 shows what happened when we did this. We selected a *range* of cells. The address of this range is A3:D21.

A range address looks like two cell addresses put together, with a colon (:) in the middle. And that's what it is! A range address starts with the address of the cell in the upper left of the range, then has a colon, and then ends with the address of the cell in the lower right.



	A	B	C	D
1	CLIENT	NAME OF PET	TYPE OF PET	DATE OF LAST VISIT
2				
3	Caryl Whaley	Paws	Cat	12/8/2006
4	Dave Kornreker	Sugar	Cat	12/8/2006
5	Portia Coyle	Queenie	Dog	12/5/2006
6	Steven Trailer	Winger	Bird	12/5/2006
7	Gwendolin Gauder	Honey	Dog	12/3/2006
8	Avis Jovinsky	Tweetie	Bird	12/2/2006
9	Tish Evert	Hunter	Cat	11/24/2006
10	Alma Pruett	Proud King	Horse	11/17/2006
11	Del Moore	Nelson	Monkey	11/16/2006
12	Mayra Pellman	Tiger	Cat	11/15/2006
13	Aurora McCracken	Pretty Girl	Bird	11/14/2006
14	Hugh Blastick	Missy	Cat	11/14/2006
15	Seiji Davis	Basil	Cat	11/11/2006
16	Greg Rabin	Baby	Cat	11/5/2006
17	Rene Lochead	Coiler	Snake	11/5/2006
18	Bernie Vambreck	Boxer	Dog	11/2/2006
19	Hans Alameda	Wally	Dog	11/2/2006
20	Trisha Hill	Climber	Cat	11/2/2006
21	Edna Wells	Royal	Dog	11/1/2006
22	William Albissonno	Parsnip	Cat	10/30/2006
23	Muriel Rosenkantz	Little Lil	Bird	10/28/2006
24	Iola Cramer	Ira	Bird	10/26/2006
25	Russell Triplett	Crawford	Dog	10/25/2006
26	Ramesh Carvalho	Perry	Cat	10/20/2006
27	Kin Sigman	Runner	Dog	10/13/2006
28	Alma Gorin	Moon	Snake	10/12/2006
29	Lyle Blank	Tarka	Ferret	10/10/2006
30	Maile Shanika	Max	Dog	10/8/2006
31	Dixie Peterkin	Freckles	Dog	10/2/2006
32	Molly Hanz	Polly	Bird	10/1/2006
33	Davidleyon Cumeau	Monis	Cat	9/25/2006
34	Rene Rybarczyk	Morris	Cat	9/20/2006
35	Victor Harandes	Hexar	Dog	9/18/2006
36	Curtiss Duddeck	Royal	Dog	9/17/2006
37	Bennie Booth	Polly	Bird	9/13/2006

Figure 1-8: Selecting a range of cells.

One more detail about ranges — you can give them a name. This is a great feature because you can think about a range in terms of what it is used for, instead of what its address is. Also, if we did not take the extra step to assign a name, the range would be gone as soon as we clicked anywhere on the worksheet. When a range is given a name, you can repeatedly use the range by using its name.

Say you have a list of clients on a worksheet. What's easier — thinking of exactly which cells are occupied, or thinking that there is your list of clients?

Throughout this book, we use areas made of cell addresses and ranges, which have been given names. It's time to get your feet wet creating a *named area.* Here's what you do:

1. **Position the mouse pointer over a cell, click and hold the left mouse button down, and drag the pointer around.**
2. **Release the mouse button when done.**

   You've select an area of the worksheet.
3. **Click Name a Range in the Named Cells category on the Formulas Ribbon.**

   The New Name dialog box appears. Figure 1-9 shows you how it looks so far.
4. **Name the area if need be.**

   Excel guesses that you want to name the area with the value it finds in the top cell of the range. That may or may not be what you want. Change the name if you need to. In this example, we changed the name to Clients.

   An alternative method to naming an area is to select it, type the name in the Name Box (left of the Formula Bar), and press the Enter key.

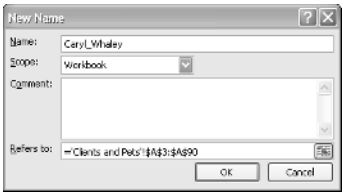


Figure 1-9: Adding a name to the workbook.

5. **Click the OK button.**

That's it. Hey, you're already on your way to being an Excel pro! Now that you have a named area, you can easily select your data at any time. Just go to the Name Box and select it from the list. Figure 1-10 shows how we select the Clients area we set up.

Tables work in much the same manner as named areas. Tables have a few features that are unavailable to simple named areas. With tables you can indicate that the top row contains header labels. Further, tables default to have filtering ability. Figure 1-11 shows a table on a worksheet, with headings and filtering ability.

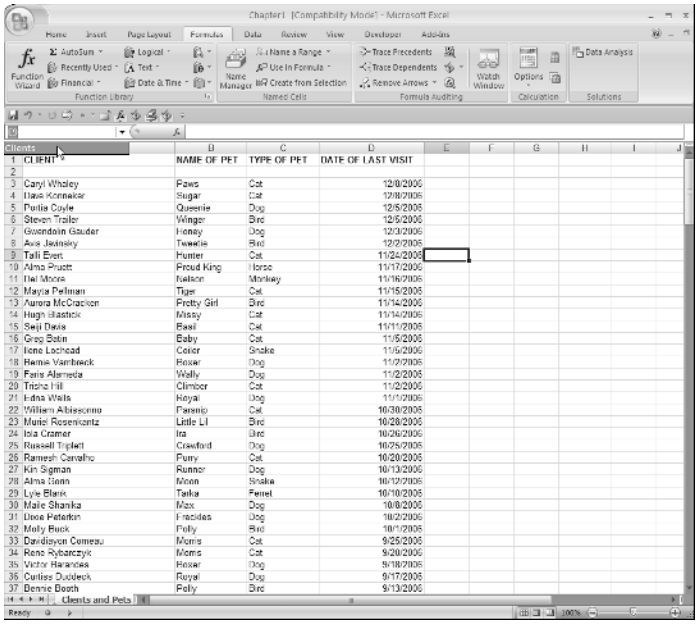


Figure 1-10: Using the Name Box to find the named area.

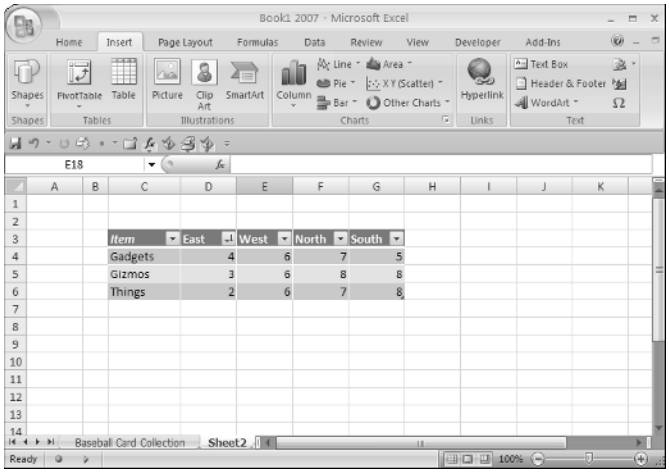


Figure 1-11: Trying out a table.

With filtering, you can limit which rows show, based on which values you select to display.

The Insert Ribbon contains the button to use for inserting a table. The Insert Ribbon is shown in Figure 1-11.

Formatting your data

Of course you want to make your data look all spiffy and shiny. Bosses like that. Is the number 98.6 someone's temperature? Is it a score on a test? Is it ninety-eight dollars and sixty cents? Is it a percentage? Any of these formats is correct:

- 98.6
- $98.60
- 98.6%

Excel lets you format your data in just the way you need. Formatting options are on the Home Ribbon, in the Number category.

Figure 1-12 shows how formatting helps in the readability and understanding of a worksheet. Cell B1 has a monetary amount and is formatted with the Accounting style. Cell B2 is formatted as a percent. The actual value in cell B2 is .05. Cell B7 is formatted as currency. The currency format displays a negative value in parentheses. This is just one of the formatting options for currency. Chapter 5 explains further about formatting currency.

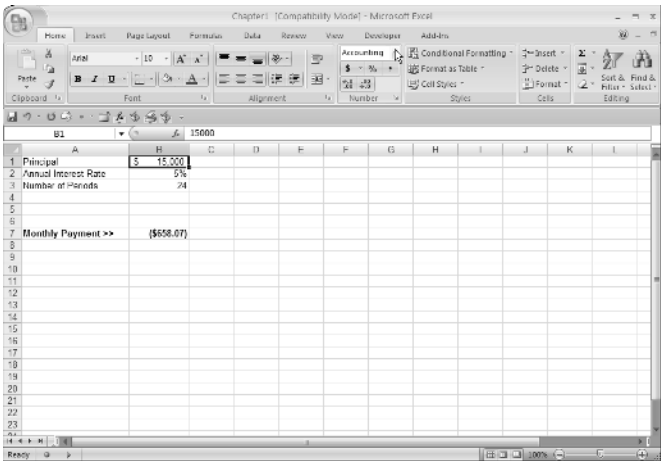


Figure 1-12: Formatting data.

Besides selecting formatting on the Home Ribbon, you can use the familiar (in previous versions) Format Cells dialog box. This is the place to go for all your formatting needs beyond what's available on the toolbar. You can even create custom formats. You can display the Format Cells dialog box two ways:

- On the Home Ribbon, click the drop-down list from the Number category, and then click More.
- Right-click any cell and select Format Cells from the pop-up menu.

Figure 1-13 shows the Format Cells dialog box. So many settings are there it can make your head spin! We discuss this dialog box and formatting more extensively in Chapter 5.

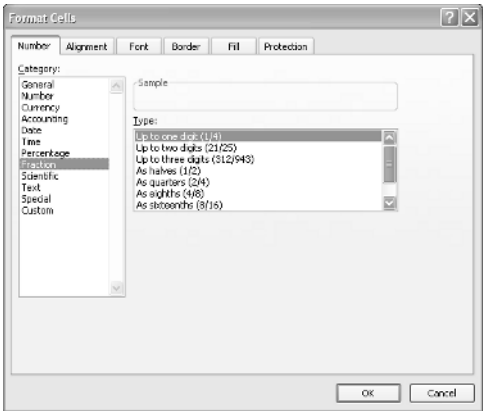


Figure 1-13: Using the Format Cells dialog box for advanced formatting options.

Getting help

Excel is complex; you can't deny that. And lucky for all of us, help is just a key press away. Yes, literally one key press — just press the F1 key. Try it now.

This starts up the Help system. From there you can search on a keyword or browse through the Help Table of Contents. Later on, when you are working with Excel functions, you can get help on specific functions directly by clicking the Help with This Function link in the Insert Function dialog box. Chapter 2 covers the Insert Function dialog box in detail.

Gaining the Upper Hand on Formulas

Okay, time to get to the nitty-gritty of what Excel is all about. Sure, you can just enter data and leave it as is, and even generate some pretty charts from it. But getting answers from your data, or creating a summary of your data, or applying what-if tests — all of this takes formulas.

To be specific, a formula in Excel calculates something, or returns some result based on data in the worksheet. A formula is placed in cells and must start with an equal sign (=) to tell Excel that it is a formula and not data. Sounds simple, and it is.

All formulas should start with an equal (=) sign. An alternative is to start a formula with a plus sign (+). This keeps Excel compatible with Lotus 1-2-3.

Look at some very basic formulas. Table 1-1 shows a few formulas and tells you what they do.

We use the word *return* to refer to what displays after a formula or function does its thing. So to say *the formula returns a 7* is the same as saying *the formula calculated the answer to be 7.*

Table 1-1 Basic Formulas

Formula	*What It Does*
`=2 + 2`	Returns the number 4.
`=A1 + A2`	Returns the sum of the values in cells A1 and A2, whatever those values may be. If either A1 or A2 has text in it, then an error is returned.
`=D5`	The cell that contains this formula ends up displaying the value that is in cell D5. If you try to enter this formula into cell D5 itself, you create a circular reference. That is a no-no. See Chapter 4.
`=SUM(A2:A5)`	Returns the sum of the values in cells A2, A3, A4, and A5. Recall from above the syntax for a range. This formula uses the SUM function to sum up all the values in the range.

Entering your first formula

Ready to enter your first formula? Make sure Excel is running and a worksheet is in front of you, and then:

1. **Click an empty cell.**
2. **Type this in:** = 10 + 10**.**
3. **Press Enter.**

That was easy, wasn't it? You should see the *result* of the formula — the number 20.

Try another. This time you create a formula that adds together the value of two cells:

1. **Click any cell.**
2. **Type in any number.**
3. **Click another cell.**
4. **Type in another number.**
5. **Click a third cell.**

   This cell will contain the formula.
6. **Type a `=`.**
7. **Click the first cell.**

   This is an important point in the creation of the formula. The formula is being written by both your keyboard entry and clicking around with the mouse. The formula should look about half complete, with an equal sign immediately followed by the address of the cell you just clicked. Figure 1-14 shows what this looks like. In the example, the value `15` has been entered into cell B3 and the value `35` into cell B6. The formula was started in cell E3. Cell E3 so far has `=B3` in it.
8. **Enter a `+`.**

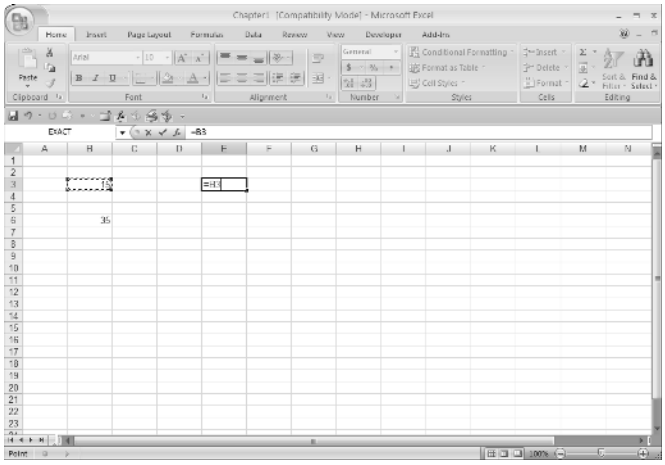


Figure 1-14: Entering a formula that references cells.

9. **Click the cell that has the second entered value.**

   In this example, this is cell B6. The formula in cell E3 now looks like this: `=B3 + B6`. You can see this is Figure 1-15.

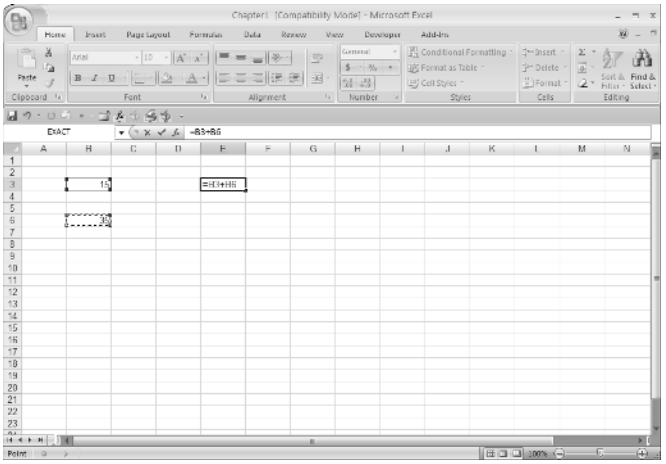


Figure 1-15: Completing the formula.

10. **Press Enter.**

    This ends the entry of the function. All done! Congratulations!

Figure 1-16 shows how the example ended up. Cell E3 displays the result of the calculation. Also notice that the Formula Bar displays the contents of cell E3, which really is the formula.

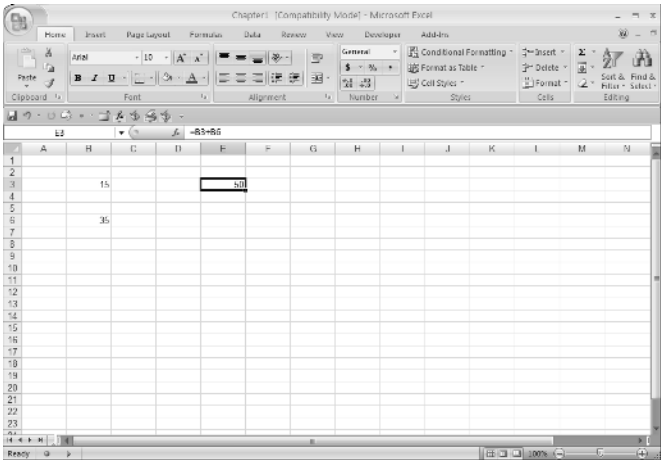


Figure 1-16: A finished formula.

Understanding references

References abound in Excel formulas. You can reference cells. You can reference ranges. You can reference cells and ranges on other worksheets. You can reference cells and ranges in other workbooks. Formulas and functions are at their most useful when using references, so you need to understand them.

And if that isn't enough to stir the pot, you can use three types of cell references: relative, absolute, and mixed. Okay, one step at a time here. Try out a formula that uses a range.

Formulas that use ranges often have a function in the formula, so use the SUM function here:

1. **Enter some numbers in many cells going down one column.**
2. **Click in another cell where you want the result to appear.**
3. **Enter** =SUM(**to start the function.**
4. **Click the first cell that has an entered value, hold the left mouse button down, and drag the mouse pointer over all the cells that have values.**
5. **Release the mouse button.**

   The range address appears where the formula and function are being entered.
6. **Enter a**).
7. **Press Enter.**
8. **Give yourself a pat on the back.**

Wherever you drag the mouse to enter the range address into a function, you can also just type in the address of the range, if you know what it is.

Excel is *dynamic* when it comes to cell addresses. If you have a cell with a formula that references a different cell's address and you copy the formula from the first cell to another cell, the address of the reference inside the formula changes. Excel updates the reference inside the formula to match the number of rows and/or columns that separate the original cell (where the formula is being copied from) from the new cell (where the formula is being copied to). This may be confusing, so try an example so you can see this for yourself:

1. **In cell B2, enter** 100**.**
2. **In cell C2, enter** =B2 * 2**.**
3. **Press Enter.**

   Cell C2 now returns the value `200`.

4. **If C2 is not the active cell, click it once.**
5. **Press Ctrl + C, or click the Copy button in the Clipboard category on the Home Ribbon.**
6. **Click cell C3.**
7. **Press Ctrl + V, or click the Paste button in the Clipboard category on the Home Ribbon.**
8. **If you see a strange moving line around cell C2, press the ESC key.**

   Cell C3 should be the active cell, but if it is not, just click it once. Look at the Formula Bar. The contents of cell C3 are `=B3 * 2`, and not the `=B2 * 2` that you copied.

Did you see a moving line around a cell? That line's called a *marquee*. It's a reminder that you are in the middle of a cut or copy operation, and the marquee goes around the cut or copied data.

What happened? Excel, in its wisdom, assumed that if a formula in cell C2 references the cell B2 — one cell to the left, then the same formula put into cell C3 is supposed to reference cell B3 — also one cell to the left.

When copying formulas in Excel, relative addressing is usually what you want. That's why it is the default behavior. Sometimes you do not want relative addressing but rather *absolute* addressing. This is making a cell reference fixed to an absolute cell address so that it does not change when the formula is copied.

In an absolute cell reference, a dollar sign ($) precedes both the column letter and the row number. You can also have a mixed reference in which the column is absolute and the row is relative or vice versa. To create a mixed reference, you use the dollar sign in front of just the column letter or row number. Here are some examples:

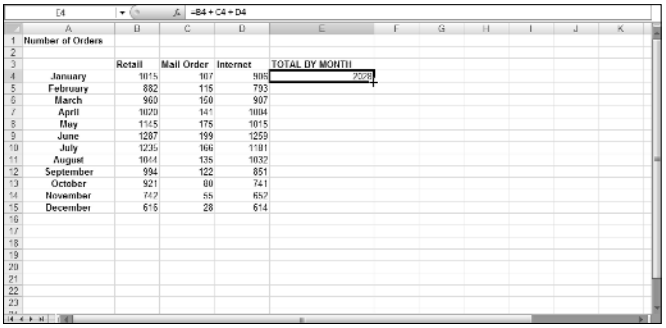
Reference Type	*Formula*	*What Happens After Copying the Formula*
Relative	`=A1`	Either, or both, the column letter A and the row number 1 can change.
Absolute	`=$A$1`	The column letter A and the row number 1 do not change.
Mixed	`=$A1`	The column letter A does not change. The row number 1 can change.
Mixed	`=A$1`	The column letter A can change. The row number 1 does not change.

Copying formulas with the fill handle

As long as we're on the subject of copying formulas around, take a look at the fill handle. You're gonna love this one! The fill handle is a quick way to copy the contents of a cell to other cells with just a single click and drag.

The active cell always has a little square box in the lower-right side of its border. That is the fill handle. When you move the mouse pointer over the fill handle, the mouse pointer changes shape. If you click and hold down the mouse button, you can now drag up, down, or across over other cells. When you let go of the mouse button, the contents of the active cell automatically copy to the cells you dragged over.

A picture is worth a thousand words, so take a look. Figure 1-17 shows a worksheet that adds some numbers. Cell E4 has this formula: `=B4 + C4 + D4`. This formula needs to be placed in cells E5 through E15. Look closely at cell E4. The mouse pointer is over the fill handle and it has changed to what looks like a small black plus sign. We are about to use the fill handle to drag that formula to the other cells. Clicking and holding the left mouse button down and then dragging down to E15 does the trick.



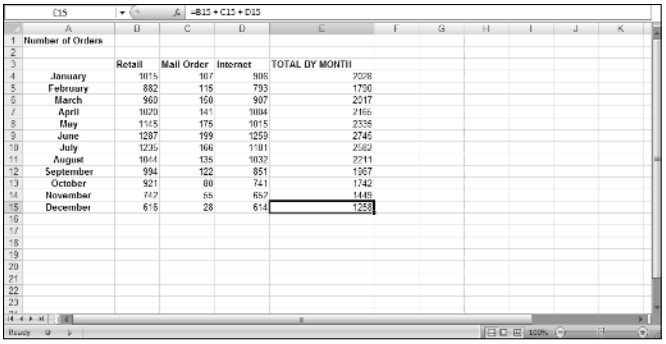
	A	B	C	D	E
1	Number of Orders				
2					
3		Retail	Mail Order	Internet	TOTAL BY MONTH
4	January	1015	107	906	2028
5	February	882	115	793	
6	March	960	150	907	
7	April	1029	141	1084	
8	May	1155	175	1015	
9	June	1287	199	1259	
10	July	1235	166	1181	
11	August	1044	135	1032	
12	September	994	122	851	
13	October	921	80	741	
14	November	747	55	657	
15	December	616	28	614	

Figure 1-17: Getting ready to drag the formula down.

Figure 1-18 shows what the worksheet looks like after the fill handle is used to get the formula into all the cells. This is a real timesaver. Also, you can see that the formula in each cell of column E correctly references the cells to its left. This is the intention of using relative referencing. For example, the formula in cell E15 ended up with this formula: `=B15 + C15 + D15`.

Assembling formulas the right way

There's a saying in the computer business: garbage in, garbage out. And that applies to how formulas are put together. If a formula is constructed the wrong way, it either returns an incorrect result or an error.



	A	B	C	D	E
1	Number of Orders				
2					
3		Retail	Mail Order	Internet	TOTAL BY MONTH
4	January	1015	107	906	2028
5	February	882	115	793	1790
6	March	960	150	907	2017
7	April	1020	141	1004	2165
8	May	1145	175	1015	2335
9	June	1287	199	1259	2745
10	July	1235	166	1181	2582
11	August	1044	135	1032	2211
12	September	994	122	851	1967
13	October	921	80	741	1742
14	November	747	55	657	1449
15	December	616	28	614	1258

Figure 1-18: Populating cells with a formula by using the fill handle.

Two types of errors can occur in formulas. In one type, Excel can calculate the formula, but the result is wrong. In the other type, Excel is not able to calculate the formula. Check out both of these.

A formula can work and still produce an incorrect result. Excel does not report an error because there is no error for it to find. Often this is the result of not using parentheses properly in the formula. Take a look at some examples:

Formula	***Result***
`=7 + 5 * 20 + 25 / 5`	`112`
`=(7 + 5) * 20 + 25 / 5`	`245`
`=7 + 5 *( 20 + 25) / 5`	`52`
`=(7 + 5 * 20 + 25) / 5`	`26.4`

All of these are valid formulas, but the placement of parentheses makes a difference in the outcome. You must take into account the order of mathematical operators when writing formulas. The order is:

1. Parentheses
2. Exponents
3. Multiplication and division
4. Addition and subtraction

This is a key point of formulas. It is easy to just accept a returned answer. After all, Excel is so smart. Right? Wrong! Like all computer programs, Excel can only do what it is told. If you tell it to calculate an incorrect but structurally valid formula, it will do so. So watch your p's and q's! Er, rather your parentheses and mathematical operators when building formulas.

The second type of error is when there is a mistake in the formula or in the data the formula uses that prevents Excel from calculating the result. Excel makes your life easier by telling you when such an error occurs. To be precise, it does one of the following:

- Excel displays a message when you attempt to enter a formula that is not constructed correctly.
- Excel returns an error message in the cell when there is something wrong with the result of the calculation.

First, let's see what happened when we tried to finish entering a formula that had the wrong number of parentheses. Figure 1-19 shows this.

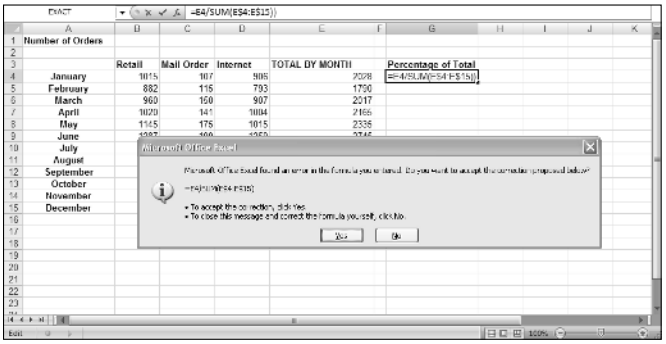


Figure 1-19: Getting a message from Excel.

Excel finds an uneven number of open and closed parentheses. Therefore the formula cannot work (it does not make sense mathematically) and Excel tells you so. Watch for these messages; they often offer a solution.

On the other side of the fence are errors in returned values. If you got this far, then the formula's syntax passed muster, but something went awry nonetheless. Possible errors are:

- Attempting to perform a mathematical operation on text
- Attempting to divide a number by 0 (a mathematical no-no)
- Trying to reference a nonexistent cell, range, worksheet, or workbook
- Entering the wrong type of information into an argument function

This is by no means an exhaustive list of possible error conditions, but you get the idea. So what does Excel do about it? There are a handful of errors that Excel places into the cell with the problem formula.

Error Type	*When It Happens*
`#DIV/0!`	When you're trying to divide by 0
`#N/A!`	When a formula or a function inside a formula cannot find the referenced data
`#NAME?`	When text in a formula is not recognized
`#NULL!`	When a space was used instead of a comma in formulas that reference multiple ranges; a comma is necessary to separate range references
`#NUM!`	When a formula has numeric data that is invalid for the operation type
`#REF!`	When a reference is invalid
`#VALUE!`	When the wrong type of operand or function argument is used

Chapter 4 discusses catching and handling formula errors in detail.

Using Functions in Formulas

Functions are like little utility programs that do a single thing. For example, the SUM function sums up numbers, the COUNT function counts, and the AVERAGE function calculates an average.

There are functions to handle many different needs: working with numbers, working with text, working with dates and times, working with finance, and so on. Functions can be combined and nested (one goes inside another). Functions return a value, and this value can be combined with the results of another function or formula. The possibilities are nearly endless.

But functions do not exist on their own. They are always a part of a formula. Now that can mean that the formula is made up completely of the function or that the formula combines the function with other functions, data, operators, or references. But functions must follow the formula golden rule: *Start with the equal sign*. Look at some examples:

Function/Formula	*Result*
`=SUM(A1:A5)`	Returns the sum of the values in the range A1:A5. This is an example of a function serving as the whole formula.
`=SUM(A1:A5) /B5`	Returns the sum of the values in the range A1:A5 divided by the value in cell B5. This is an example of mixing a function's result with other data.

`=SUM(A1:A5) + AVERAGE(B1:B5)`	Returns the sum of the range A1:A5 added with the average of the range B1:B5. This is an example of a formula that combines the result of two functions.

Ready to write your first formula with a function in it? This function creates an average:

1. **Enter some numbers in a column's cells.**
2. **Click an empty cell where you want to see the result.**
3. **Enter** =AVERAGE(**to start the function.**

   Note: New in Excel 2007, Excel presents a list of functions that have the same spelling as the function name you type. The more letters you type, the shorter the list becomes. The advantage is, for example, typing the letter A, using the ↓ to select the AVERAGE function, and then pressing the Tab key.
4. **Click the first cell with an entered value and, while holding the mouse button, drag the mouse pointer over the other cells that have values.**

   An alternative is to enter the range of those cells.
5. **Enter a**).
6. **Press Enter.**

If all went well, your worksheet should look a little bit like ours, in Figure 1-20. Cell B10 has the calculated result, but look up at the Formula Bar and you can see the actual function as it was entered.

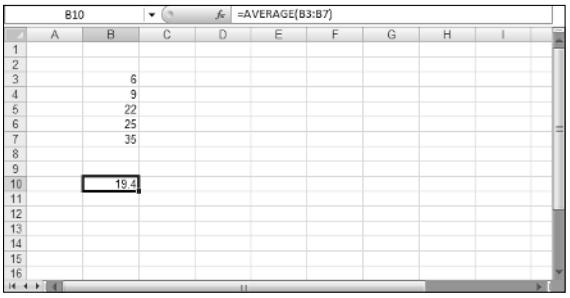


Figure 1-20: Entering the AVERAGE function.

Formulas and functions are dependent on the cells and ranges to which they refer. If you change the data in one of the cells, the result returned by the function updates. You can try this now. In the example you just did with making an average, click into one of the cells with the values and enter a different number. The returned average changes.

A formula can consist of nothing but a single function — preceded by an equal sign, of course!

Looking at what goes into a function

Most functions take inputs — called *arguments* or *parameters* — that specify the data the function is to use. Some functions take no arguments, some take one, and others take many — it all depends on the function. The argument list is always enclosed in parentheses following the function name. If there's more than one argument, they are separated by commas. Look at a few examples:

Function	***Comment***
`=NOW()`	Takes no arguments.
`=AVERAGE(A6,A11,B7)`	Can take up to 255 arguments. Here, three cell references are included as arguments. The arguments are separated by commas.
`=AVERAGE(A6:A10,A13:A19,A23:A29)`	In this example, the arguments are range references instead of cell references. The arguments are separated by commas.
`=IPMT(B5, B6, B7, B8)`	Requires four arguments. Commas separate the arguments.

Some functions have required arguments and optional arguments. You must provide the required ones. The optional ones are well, optional. But you may want to include them if their presence helps the function return the value you need.

The IPMT function is a good example. Four arguments are required and two more are optional. You can read more about the IPMT function in Chapter 5. You can read more about function arguments in Chapter 2.

Arguing with a function

Memorizing the arguments that every function takes would be a daunting task. We can only think that if you could pull that off you could be on television. But back to reality, you don't have to memorize them because Excel helps you select what function to use, and then tells you which arguments are needed.

Figure 1-21 shows the Insert Function dialog box. This great helper is accessed by clicking the Function Wizard button on the Formulas Ribbon. The dialog box is where you select a function to use.

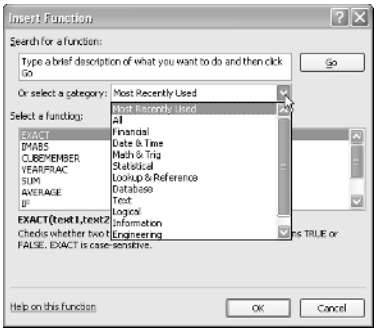


Figure 1-21: Using the Insert Function dialog box.

The dialog box contains a listing of all available functions — and there are a lot of them! So to make matters easier, the dialog box gives you a way to search for a function by a keyword, or you can filter the list of functions by category.

If you know which category a function belongs in, you can click the function category button in the Formulas Ribbon and select the function from the list.

Try it out! Here's an example of how to use the Insert Function dialog box to multiply together a few numbers:

1. **Enter three numbers in three different cells.**
2. **Click an empty cell where you want the result to appear.**
3. **Click the Function Wizard button on the Formulas Ribbon.**

   As an alternative, you can just click the little *fx* button on the Formula Bar. The Insert Function dialog box appears.
4. **Select either All or Math & Trig.**
5. **In the list of functions, find and select the PRODUCT function.**
6. **Click the OK button.**

   This closes the Insert Function dialog box and displays the Function Arguments dialog box (see Figure 1-22), where you can enter as many arguments as needed. Initially it might not look like it can accommodate enough arguments. You need to enter three in this example, but it looks like there is only room for two. This is like musical chairs!

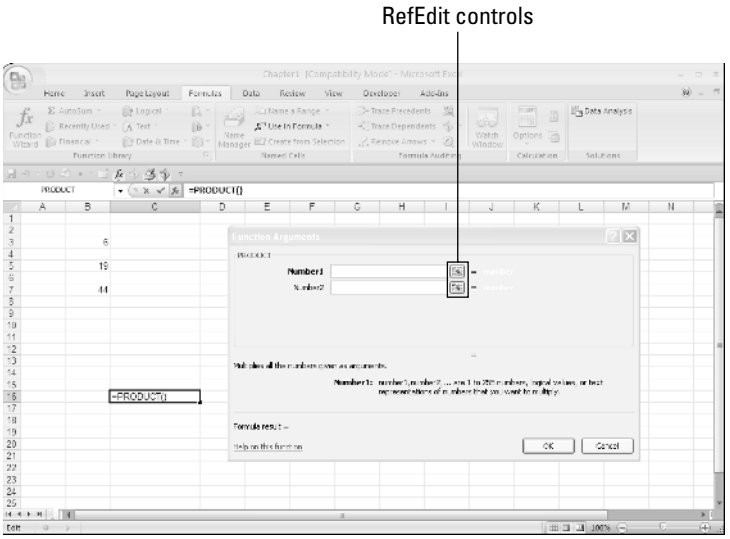


Figure 1-22: Getting ready to enter some arguments to the function.

More argument entry boxes appear as you need them. First, though, how do you enter the argument? There are two ways.

7. **Enter the argument one of two ways:**

   - **Type the numbers or cell references into the boxes.**
   - **Use those funny-looking squares to the right of the entry boxes.**

   In Figure 1-22 two entry boxes are ready to go. To the left of them are the names Number1 and Number2. To the right of the boxes are the little squares. These squares are actually called *RefEdit controls.* They make argument entry a snap. All you do is click one, click the cell with the value, and then press Enter.

8. **Click the RefEdit control to the right of the Number1 entry box.**

   The Function Arguments dialog box shrinks to just the size of the entry box.

9. **Click the cell with the first number.**

   Figure 1-23 shows what the screen looks like at this point.

10. **Press Enter.**

    The Function Arguments dialog box reappears with the argument entered into the box. The argument is not the value in the cell, but instead is the address of the cell that contains the value — exactly what you want.

11. **Repeat Steps 7–9 to enter the other two cell references.**

    Figure 1-24 shows what the screen should now look like.

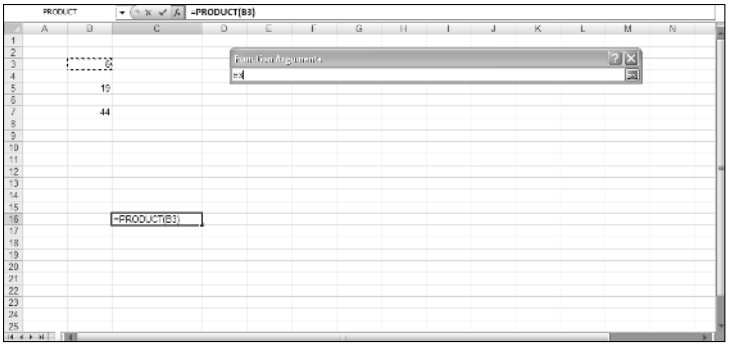


Figure 1-23: Using RefEdit to enter arguments.

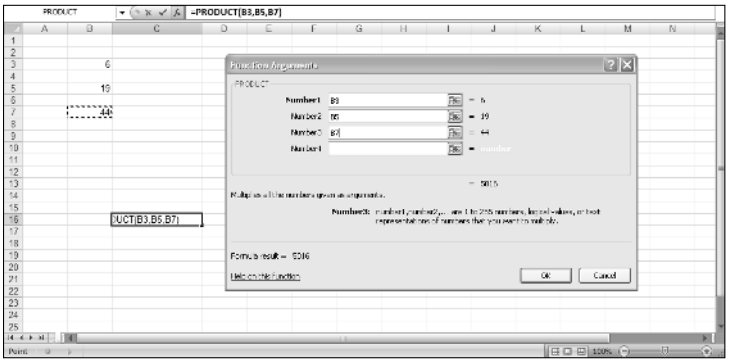


Figure 1-24: Completing the function entry.

12. Click OK or press Enter to complete the function.

Figure 1-25 shows the result of all this hoopla. The PRODUCT function returns the result of the individual numbers being multiplied together.

You do not have to use the Insert Function dialog box to enter functions into cells. It is there for convenience. As you become familiar with certain functions that you use repeatedly, you may find it faster to just type the function directly into the cell.

Nesting functions

Nesting is something a bird does, isn't it? Well, a bird expert would know the answer to that one, but we do know how to nest Excel functions. A *nested function* is tucked inside another function, as one of its arguments. Nesting functions let you return results you would have a hard time getting to otherwise. (Nested functions are used in examples in various places in the book. The COUNTIF, AVERAGE, and MAX functions are discussed in Chapter 9.)

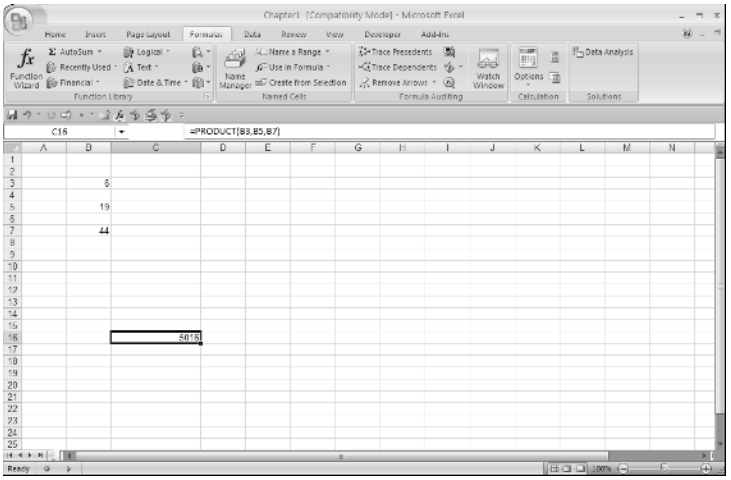


Figure 1-25: Math was never this easy!

Figure 1-26 shows the daily closing price for the S&P 500, for the month of September 2004. A possible analysis is to see how many times the closing price was higher than the average for the month. Therefore, the average needs to be calculated first, before you can compare any single price. By embedding the AVERAGE function inside another function, the average is first calculated.

When a function is nested inside another, the inner function is calculated first. Then that result is used as an argument for the outer function.

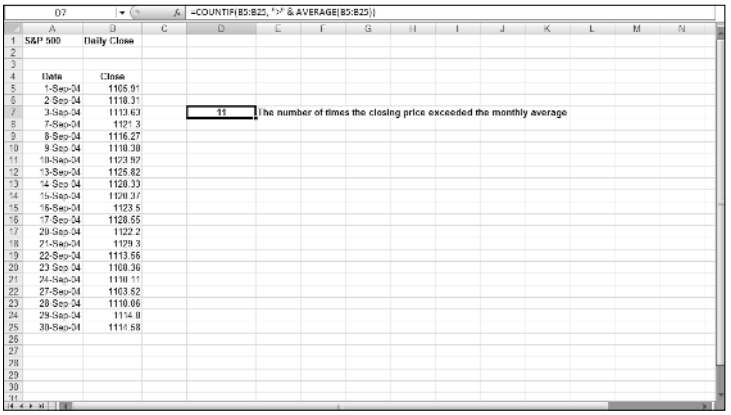


Figure 1-26: Nesting functions.

The COUNTIF function counts the number of cells in a range that meet a condition. The condition in this case is that any single value in the range is greater than (>) the average of the range. The formula in cell D7 is `=COUNTIF(B5:B25, ">" & AVERAGE(B5:B25))`. The AVERAGE function is evaluated first, and then the COUNTIF function is evaluated using the returned value from the nested function used as an argument.

Nested functions are best entered directly. The Insert Function dialog box does not make it easy to enter a nested function. Try one out. In this example, you use the AVERAGE function to find the average of the largest values from two sets of numbers. The nested function in this example is MAX. You enter the MAX function twice within the AVERAGE function:

1. **Enter a few different numbers in one column.**
2. **Enter a few different numbers in a different column.**
3. **Click an empty cell where you want the result to appear.**
4. **Enter** =AVERAGE(**to start the function entry.**
5. **Enter** MAX(**.**
6. **Click the first cell in the second set of numbers, press the mouse button, and drag over all the cells of the first set.**

   The address of this range enters into the MAX function.
7. **Enter a closing parenthesis to end the first MAX function.**
8. **Enter a comma (,).**
9. **Once again, enter** MAX(**.**
10. **Click the first cell in the second set of numbers, press the mouse button, and drag over all the cells of the second set.**

    The address of this range enters into the MAX function.
11. **Enter a closing parenthesis to end the second MAX function.**
12. **Enter a**)**.**

    This ends the AVERAGE function.
13. **Press Enter.**

Figure 1-27 shows the result of your nested function. Cell C14 has this formula: `=AVERAGE(MAX(B4:B10),MAX(D4:D10))`.

When using nested functions, the outer function is preceded with an equal sign (=) if it is the beginning of the formula. Any nested functions are *not* preceded with an equal sign.

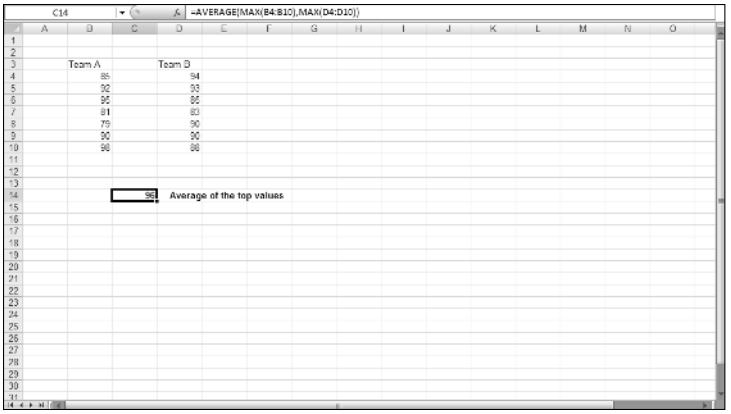


Figure 1-27: Getting a result from nested functions.

You can nest functions up to 64 levels.